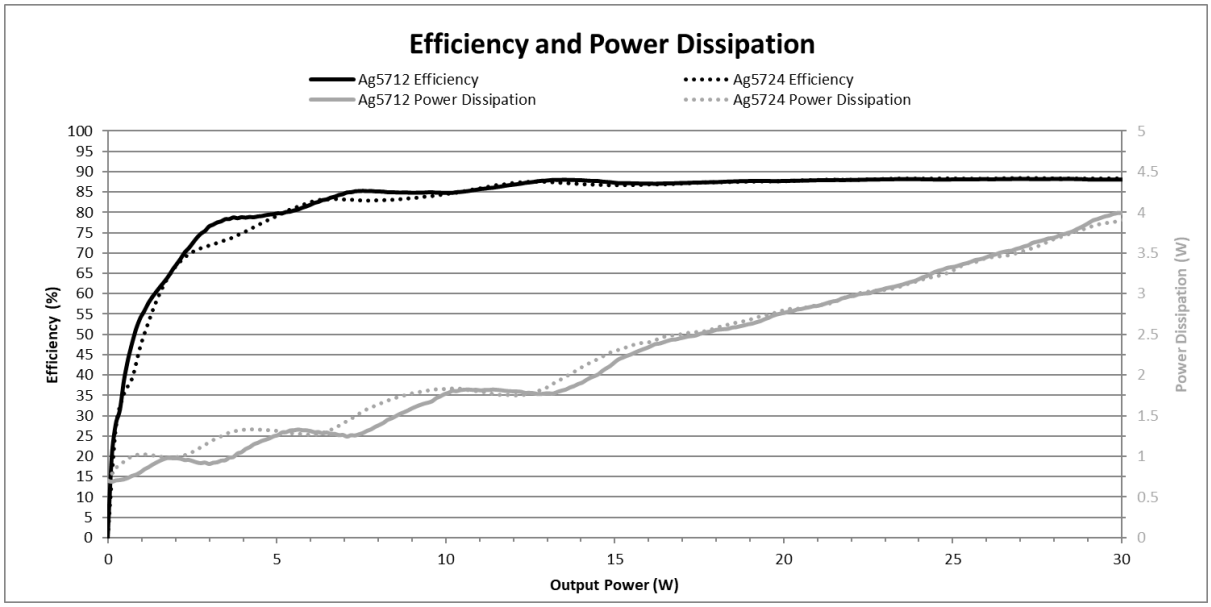
Ag5700
Thermal considerations

The following document details the thermal performance of the Ag5700 series for use with designing thermal management when integrating into an application.

The Ag5700 module is a compact power converter module that will generate heat in the small footprint. The amount of heat generated by the module will depend on the load it is required to drive. To ensure continuous operation at maximum power, it is important that any enclosure used to house the application should have sufficient heatsinking, ventilation, and airflow over the Ag5700 to dissipate the highest average power demand of the Ag5700 as well as the power dissipation of the application circuitry to limit the temperature elevation inside the enclosure.

The Ag5700 series is capable of sourcing up to 30W of power to an application, however it should be noted that the module may shut down as a result of the thermal protection if the heat generated is not removed from the device.

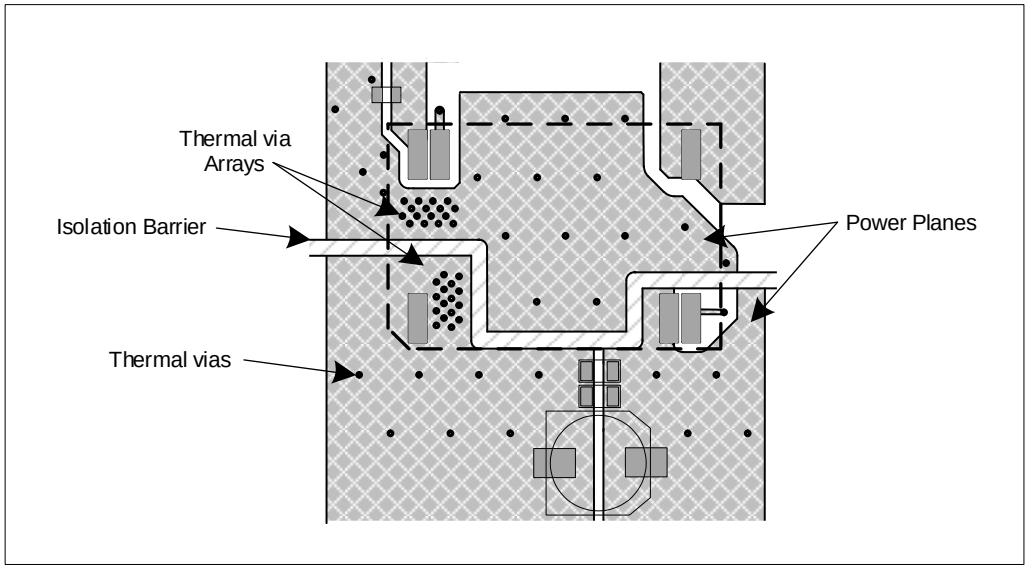
The module can achieve 87-89% efficiency across the majority of its output range, and with a peak power dissipation in the module of 4W.



Ag5712 & Ag5724 Efficiency and Power Dissipation

It is always preferential to have enough air movement in a system to remove any static pockets of elevated temperature air surrounding the components on the module. Using the combination of thermal planes, vias, and thermal interface material under the module to draw heat away from the highest power dissipating components and spread the energy over a larger surface area will greatly assist the thermal management of the module.

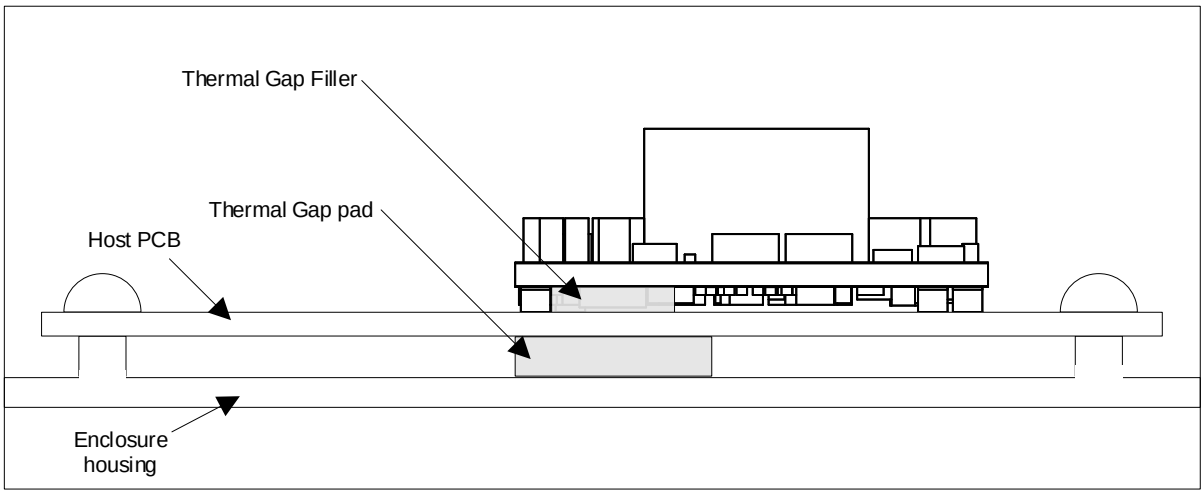
An example layout of the thermal planes and vias is shown below. Arrays of thermal vias are used below the location of the highest power dissipating components to more effectively spread the thermal energy between the layers of the application PCB. The Thermal interface material will have the most effect in this region.



Ag5700 suggested Thermal plane layout

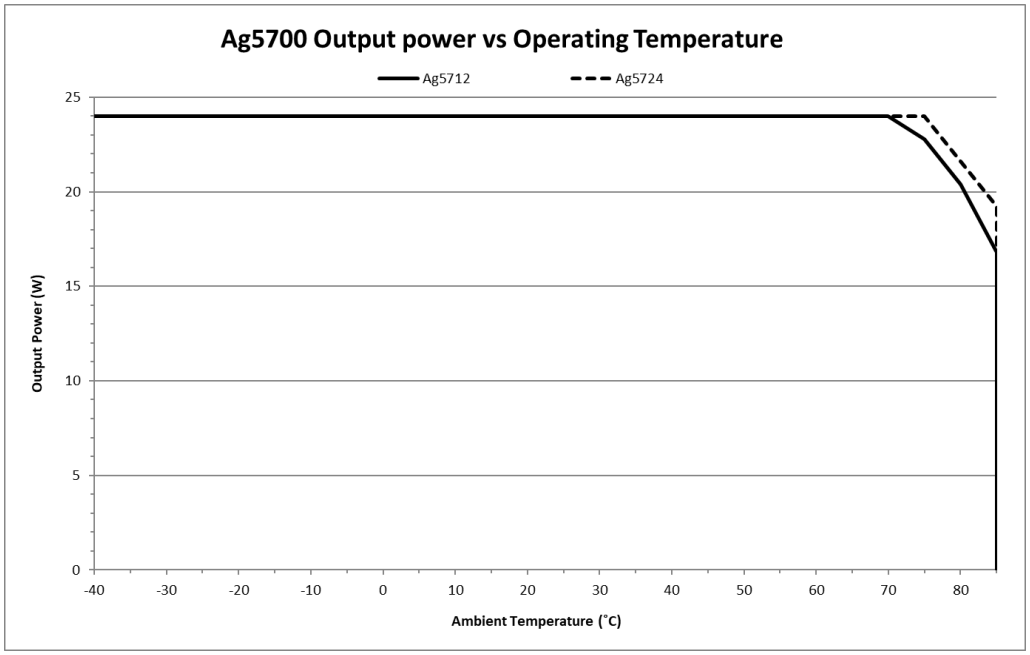
The thermal management of the application can be further improved by heatsinking the application PCB to the enclosure walls using a gap pad. This allows the thermal energy of the application PCB to be dissipated to the air surrounding the enclosure rather than the elevated ambient temperature inside the enclosure.

For optimal affect, gap pads should be placed such that they provide the greatest reduction in thermal resistance from the highest power dissipating components to the enclosure wall, in the case of the Ag5700, this would be covering the thermal via arrays as shown below.



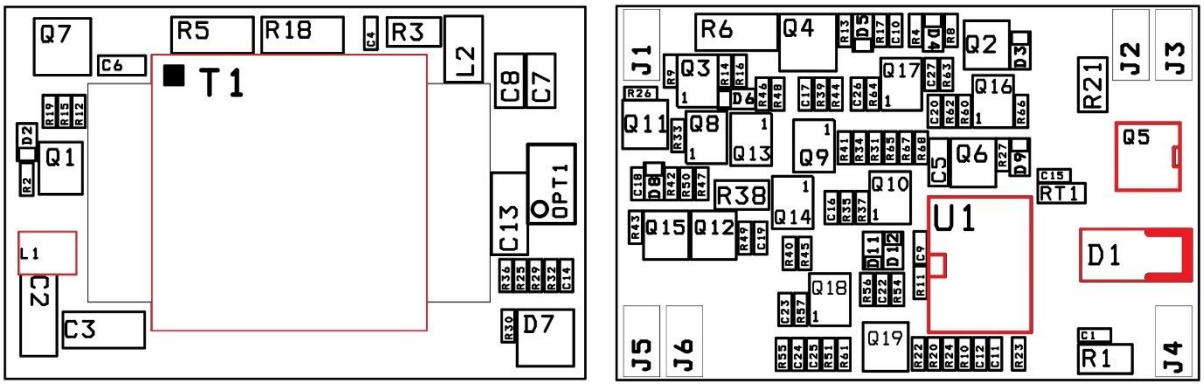
Ag5700 Enclosure Heatsinking

The following tests show typical component temperatures while operating in ambient temperatures between -40˚C and 85˚C. These tests were performed in a Temperature Applied Sciences Ltd ECO MT135 Environmental chamber with circulating air at a rate of approximately 0.5m/s over the Ag5700 module while mounted onto an EvalAg5700 evaluation board with Parker Chomerics THERM-A-GAP GEL 37 applied under the module, as per the datasheet application region diagram.



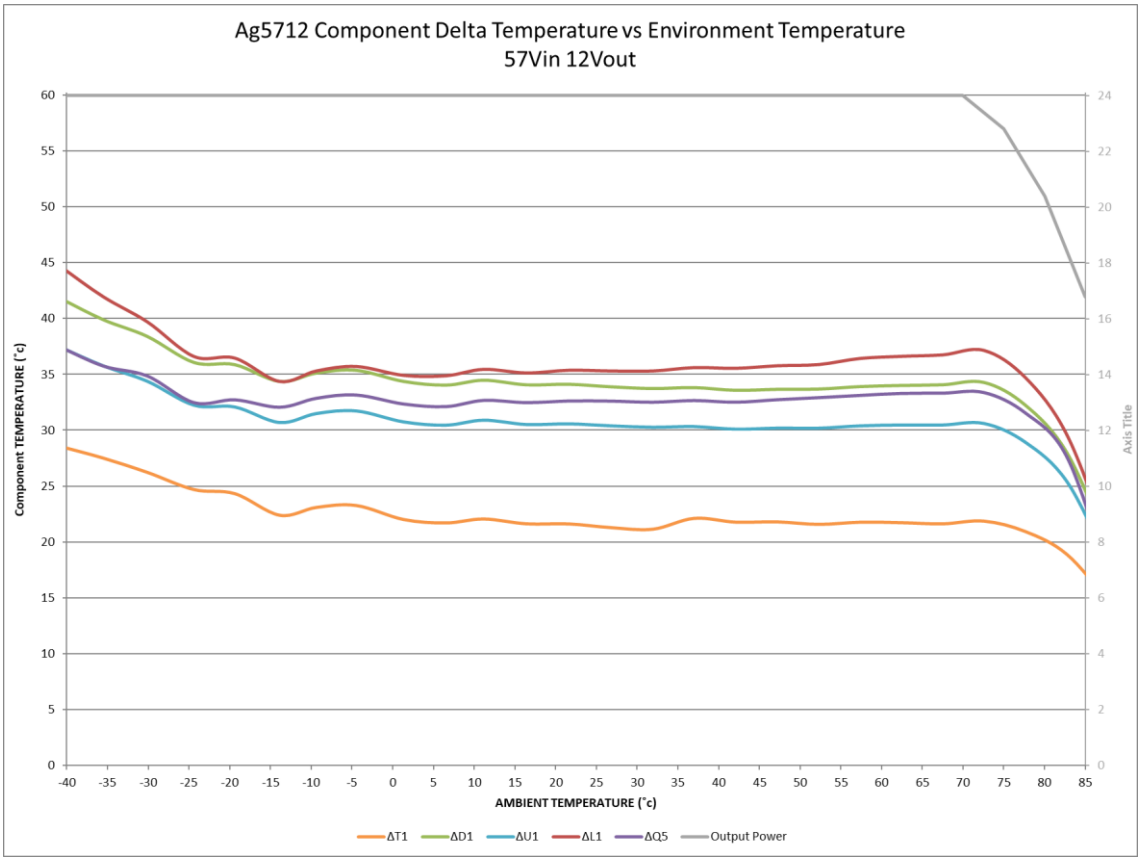
Ag5700 operating temperature profile

Highlighted below are the hottest components on the Ag5712 and Ag5724 module.



Ag5712 & Ag5724 Hottest Components

In this setup the hottest component on the Ag5712 is the output inductor L1. Below shows the temperature of the components relative to the ambient temperature of the chamber for the module outputting 12V with a 57V supply. For example, at a 25˚C ambient temperature the components were operating 30-35˚C above ambient, meaning that they will be operating at 55-60˚C.

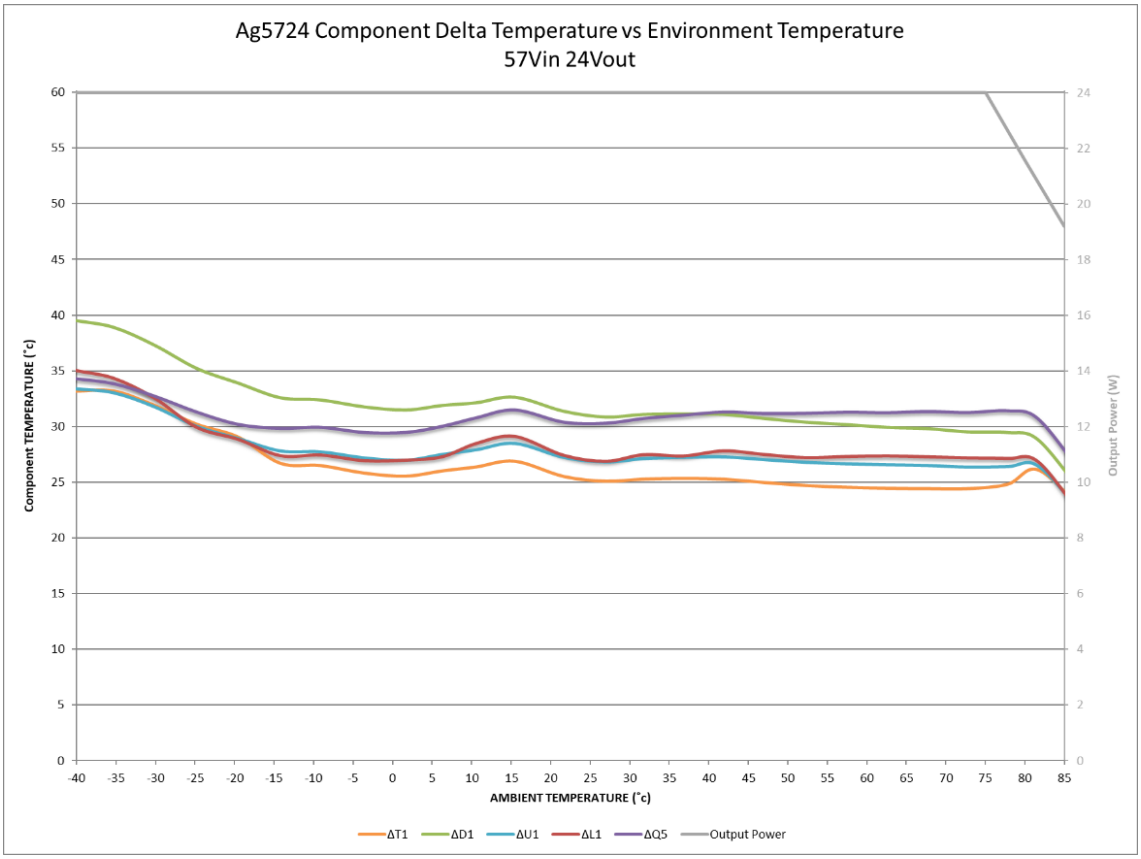


Ag5712 delta component temperature

Chamber Temperature (˚c)	T1 Temperature (˚c)	D1 Temperature (˚c)	U1 Temperature (˚c)	L1 Temperature (˚c)	Q5 Temperature (˚c)	Supply Voltage (V)	Supply Current (A)	Output Voltage (V)	Output Current (A)
-40	-12.32	0.96	-3.42	3.78	-3.40	57	0.5	12	2
-35	-8.04	4.36	0.21	6.37	0.22	57	0.5	12	2
-30	-3.91	8.27	4.24	9.53	4.73	57	0.5	12	2
-25	0.27	11.67	7.83	12.17	8.07	57	0.5	12	2
-20	4.94	16.50	12.70	17.05	13.36	57	0.5	12	2
-15	8.51	20.51	16.81	20.47	18.20	57	0.5	12	2
-10	13.72	25.77	22.12	25.92	23.51	57	0.5	12	2
-5	18.81	30.93	27.27	31.23	28.72	57	0.5	12	2
0	23.35	35.73	32.08	36.23	33.70	57	0.5	12	2
5	28.26	40.61	37.01	41.41	38.69	57	0.5	12	2
10	33.22	45.66	42.06	46.59	43.85	57	0.5	12	2
15	38.05	50.51	46.93	51.54	48.92	57	0.5	12	2
20	43.22	55.74	52.17	56.96	54.24	57	0.5	12	2
25	48.06	60.69	57.17	62.06	59.40	57	0.5	12	2
30	53.06	65.68	62.19	67.21	64.45	57	0.5	12	2
35	59.12	70.85	67.33	72.60	69.69	57	0.5	12	2
40	63.87	75.70	72.20	77.63	74.63	57	0.5	12	2
45	69.01	80.90	77.41	82.97	79.97	57	0.5	12	2
50	73.90	86.03	82.51	88.19	85.26	57	0.5	12	2
55	79.14	91.30	87.77	93.78	90.51	57	0.5	12	2
60	84.13	96.43	92.87	99.00	95.72	57	0.5	12	2
65	89.14	101.61	97.99	104.25	100.86	57	0.5	12	2
70	94.47	106.91	103.21	109.73	106.00	57	0.5	12	2
75	98.61	109.95	106.60	112.38	109.25	57	0.5	12	1.9
80	101.66	110.81	108.18	112.38	110.42	57	0.4	12	1.7
85	102.60	107.63	106.04	107.96	104.97	57	0.3	12	1.4

Ag5712 component temperature

In this setup the hottest component on the Ag5724 is the output Diode D1. Below shows the temperature of the components relative to the ambient temperature of the chamber for the module outputting 24V with a 57V supply. For example, at a 25˚C ambient temperature the components were operating 25-30˚C above ambient, meaning that they will be operating at 50-55˚C.



Ag5724 delta component temperature

Chamber Temperature (˚c)	T1 Temperature (˚c)	D1 Temperature (˚c)	U1 Temperature (˚c)	L1 Temperature (˚c)	Q5 Temperature (˚c)	Supply Voltage (V)	Supply Current (A)	Output Voltage (V)	Output Current (A)
-40	-7.24	-0.83	-7.02	-5.35	-6.06	57	0.5	24	1
-35	-2.19	3.57	-2.36	-1.04	-1.50	57	0.5	24	1
-30	1.68	7.12	1.54	2.34	2.53	57	0.5	24	1
-25	5.35	10.39	5.16	5.08	6.47	57	0.5	24	1
-20	9.50	14.37	9.37	9.31	10.66	57	0.5	24	1
-15	12.44	18.35	13.56	13.14	15.60	57	0.5	24	1
-10	17.38	23.29	18.62	18.34	20.84	57	0.5	24	1
-5	22.24	28.20	23.61	23.37	25.91	57	0.5	24	1
0	27.21	33.18	28.65	28.67	31.16	57	0.5	24	1
5	32.26	38.16	33.74	33.55	36.28	57	0.5	24	1
10	36.91	42.69	38.45	39.03	41.34	57	0.5	24	1
15	42.33	48.10	43.94	44.57	46.96	57	0.5	24	1
20	47.14	53.02	48.86	49.05	52.04	57	0.5	24	1
25	52.03	57.81	53.78	53.84	57.27	57	0.5	24	1
30	56.93	62.76	58.79	59.15	62.41	57	0.5	24	1
35	62.19	67.99	64.08	64.22	67.90	57	0.5	24	1
40	67.17	73.01	69.18	69.74	73.23	57	0.5	24	1
45	72.08	77.85	74.15	74.62	78.31	57	0.5	24	1
50	77.00	82.70	79.10	79.53	83.52	57	0.5	24	1
55	81.97	87.61	84.09	84.75	88.74	57	0.5	24	1
60	87.04	92.52	89.16	89.96	93.85	57	0.5	24	1
65	92.17	97.57	94.26	95.04	99.13	57	0.5	24	1
70	97.25	102.36	99.20	100.03	104.11	57	0.5	24	1
75	102.66	107.31	104.25	104.98	109.28	57	0.5	24	1
80	107.72	110.46	108.09	108.49	112.35	57	0.4	24	0.9
85	109.82	111.31	109.50	109.22	113.06	57	0.4	24	0.8

Ag5724 component temperature